

different observations were respectively, —150, —5, —525, and —324 volts, the snow beginning a little before, and ending a little after the last observations.

These observations at Ithaca seem to strongly confirm the statement first made by Wislizenus, and subsequently hinted at by many observers, that a negative value, during winter months and under certain conditions of weather, is almost always an indication of snowfall within a certain distance of the place of observation.

During the snowfall at the place of observation the values are, as a rule, positive, and increasing during the continuance of the snow, or, if negative, the values decrease with the continuance of snow, which is virtually the same condition.

The highest positive values occurred on the following dates, with, in every case, close connection with snow: On 2d, value 800 volts, during light snow; on 3d, value 1,200 volts, during light snow; on 4th, 2,200 volts, during light snow; on the 15th, 2,270 volts, during light snow, 2,500 volts, during heavy snow, 960 volts, during light snow; on the 25th, 615 volts, during light snow; on the 26th, 1,550 to 2,000 volts, during light snow; on 27th, 2,300 volts, following snow one hour.

The values nearest zero were as follows, marked, as a rule, by cloudy, threatening weather: On November 29th, 7 volts, during threatening weather; on December 5th, 35 volts, during threatening weather; on the 7th, 5 volts, and on the 16th, 0 to —10 volts, during threatening weather; and on the 19th, 0 volts, during threatening weather. It may be of interest to note that for the first date given rain followed in twelve hours; on the second date snow followed in three hours; on the third date snow followed in one hour and fifty minutes; and on the fourth date snow followed in thirty minutes. For the 19th no precipitation is recorded within forty hours, although the weather remained for some time threatening and cloudy.

The highest negative values occurred on December 14th, 350 volts, during threatening weather, preceding snow twelve hours; on December 16th, 400 volts, during light snow, which soon ended; on December 18th, 668 volts, during light rain; and on December 25th, during light snow.

On chart vi is plotted the observations made during the month of December, 1886, at Boston, Ithaca, and New Haven. The observations for the present are made at 9 a. m., 11 a. m., 1 p. m., and 3 p. m. In the case of Boston, considering the curve generally, we notice that there are four periods of marked fluctuation, namely, December 5-6th, December 15-16th, December 25th, and December 29th. All these are found to correspond with certain atmospheric disturbances, and it is very evident that these fluctuations are closely connected with the movements of storm-areas. In this special case, the dates mentioned above are dates of heavy snow at Boston. To some extent there is an agreement between the dates of marked fluctuation at Boston and Ithaca, and there seems to be, as might be anticipated, a certain time difference between the two places. Thus, at Ithaca, the highest positive values on the 4th and 15th appear to precede by some hours the highest positive values obtained at Boston. But the snow began at Ithaca on 4th at 7.45 a. m., while it did not begin at Boston until 8.15 a. m. of the 5th, and on the 15th snow began at Ithaca during the early morning while it did not begin at Boston until 11.30 p. m. of the 15th; or the time difference between certain electrometer indications at two places is connected with their distance from the disturbing influences.

OPTICAL PHENOMENA.

SOLAR HALOS.

Solar halos were observed in the various states and territories on the following dates:

Arizona.—4th, 6th, 16th, 28th.
California.—1st, 3d, 4th, 10th, 15th, 16th, 22d, 28th, 31st.
Colorado.—2d, 5th, 9th, 12th.
Dakota.—1st to 4th, 6th, 11th, 23d, 26th, 27th, 29th, 31st.
Florida.—4th, 8th, 25th, 28th.
Georgia.—29th, 31st.

Idaho.—21st.
Illinois.—3d, 7th, 11th, 15th, 16th, 20th, 22d, 23d, 25th, 27th, 28th, 30th.
Indiana.—2d.
Iowa.—3d, 27th, 29th.
Kansas.—1st, 13th, 21st, 22d, 23d, 27th, 28th, 29th, 31st.
Kentucky.—3d.
Maine.—22d, 24th, 30th.
Massachusetts.—4th, 10th, 27th.
Michigan.—7th, 8th, 10th, 11th, 17th, 18th, 20th, 22d, 25th, 27th, 28th, 30th.
Minnesota.—1st to 4th, 11th, 14th, 20th, 22d, 23d, 26th, 27th, 29th.
Missouri.—19th.
Montana.—3d, 5th, 25th, 29th.
Nebraska.—30th, 31st.
Nevada.—26th.
New Hampshire.—6th.
New Jersey.—3d, 4th, 26th, 28th, 29th.
New York.—5th, 10th, 16th, 17th, 23d, 28th, 29th, 30th.
North Carolina.—1st, 8th, 9th, 12th, 14th, 17th, 19th, 24th, 28th.
Ohio.—4th, 7th, 10th, 15th, 20th, 25th, 26th, 28th, 30th.
Oregon.—18th, 20th.
Pennsylvania.—17th, 23d.
South Carolina.—8th, 9th, 28th, 29th.
Tennessee.—8th, 9th, 18th, 20th, 25th, 26th.
Texas.—7th, 27th.
Vermont.—10th, 23d, 30th.
Virginia.—9th, 19th.
Wisconsin.—1st, 11th, 18th, 24th, 27th to 30th.
Wyoming.—1st, 2d, 5th, 11th, 15th, 21st.

LUNAR HALOS.

Lunar halos were observed in the various states and territories on the following dates:

Alabama.—7th, 8th, 9th.
Arizona.—3d to 9th, 28th, 29th.
Arkansas.—7th, 8th, 10th.
California.—1st to 5th, 10th, 11th, 15th, 30th, 31st.
Colorado.—6th, 9th.
Connecticut.—4th, 10th.
Dakota.—2d, 6th, 7th, 9th, 10th, 15th.
District of Columbia.—11th.
Florida.—4th, 7th, 8th, 9th, 17th, 30th.
Georgia.—7th, 8th, 9th, 31st.
Idaho.—2d, 4th, 6th, 10th, 19th.
Illinois.—3d, 6th, 10th, 11th, 14th, 15th, 28th, 30th, 31st.
Indiana.—3d, 6th, 7th, 11th, 18th.
Indian Territory.—7th, 10th.
Iowa.—3d, 6th, 9th, 11th, 13th, 19th, 20th, 31st.
Kansas.—1st, 2d, 3d, 5th, 6th, 9th, 10th, 15th, 16th, 18th, 22d, 29th, 31st.
Kentucky.—3d, 4th, 8th.
Louisiana.—7th, 30th.
Maine.—4th, 6th, 7th, 11th, 29th.
Maryland.—11th.
Massachusetts.—4th, 6th, 10th, 11th, 18th.
Michigan.—4th, 5th, 7th to 10th, 17th, 29th, 30th.
Minnesota.—1st, 5th, 6th, 8th, 9th, 14th, 16th, 17th.
Mississippi.—7th.
Missouri.—6th.
Montana.—5th, 7th, 9th, 12th, 29th.
Nebraska.—6th, 7th, 9th, 10th, 11th, 13th, 31st.
Nevada.—1st, 6th, 10th.
New Hampshire.—4th, 6th, 10th, 14th, 19th.
New Jersey.—4th, 7th, 11th, 14th, 26th.
New Mexico.—6th.
New York.—4th, 5th, 10th, 11th, 28th.
North Carolina.—3d, 4th, 8th, 9th, 13th, 30th.
Ohio.—1st, 2d, 7th, 8th, 11th, 15th, 17th, 30th.
Oregon.—1st, 4th, 5th, 7th, 30th.

Pennsylvania.—4th, 11th, 12th, 19th.
Rhode Island.—4th.
South Carolina.—3d to 8th, 9th, 10th, 13th.
Tennessee.—3d, 6th, 7th, 8th, 9th.
Texas.—5th to 8th, 10th, 12th, 17th.
Utah.—4th, 5th, 6th, 8th.
Vermont.—7th.
Virginia.—3d, 7th, 9th, 11th, 13th, 14th, 19th.
Washington Territory.—1st, 6th, 10th, 30th.
West Virginia.—2d, 6th, 7th, 8th, 11th.
Wisconsin.—1st, 4th, 6th, 8th, 9th, 10th, 20th, 29th.
Wyoming.—2d, 6th, 9th, 15th, 30th.

The phases of the moon (Washington mean time) during December, as given in "The American Ephemeris and Nautical Almanac" for 1886, are as follows: New moon, 24th, 16 h. 46.5 m.; first quarter, 2d, 21 h. 16.8 m.; full moon, 10th, 16 h. 22.0 m.; last quarter, 17th, 13 h. 30.9 m.; apogee, 2d, 21.8 h. and 30th, 19.1 h.; perigee, 15th, 6.9 h.

MIRAGE.

Fort Assinaboine, Montana: the phenomenon of mirage appeared twice during the 11th. It was first seen during the morning from 8.20 to 8.55, local time. The Fort Belknap Indian agency, twenty-eight miles north of Fort Assinaboine, was plainly visible. Objects appeared magnified to immense proportion and were not inverted but in their proper position. The agency appeared to be surrounded by a dense forest although it is really situated in the midst of an open prairie, but some timber along the Milk River between this place and the agency may explain the appearance of forest. The second mirage was visible towards the west during the greater part of the afternoon; two small lakes, sixteen miles distant and ordinarily hidden from view by a range of high bluffs on the west side of Little Sandy Creek, were plainly visible, the water having a wavy motion, as if stirred by the wind. The sun was shining brightly at the time of both observations.

The following is from the "Independent" of December 18, 1886, published in Inyo, California:

On the morning of the 11th, from the road just south of Independence, California, a very beautiful mirage was seen. A low ridge, about three miles south of the town, shuts off the view of Owens Lake, about twenty-two miles away. In the mirage the whole surface of the lake was seen, with islands and headlands. The mountain on the northeast corner of the lake appeared to come close down to the water, and was as clearly reflected in its depth as in a mirror. Indeed, the entire surface of the phantom lake looked like a great mirror in which the mountains on both sides were reflected.

Saint Vincent, Minnesota: at 7.30 a. m. of the 26th the phenomenon of mirage was seen to the south, the images of trees, houses, barns, etc., were lifted into view.

Mirages were also observed at the following places:

Arizona.—Maricopa, 16th.
Dakota.—Webster, 4th; Henry, 7th.
Kansas.—Salina, 4th, 6th, 9th, 13th, 14th.
Montana.—Poplar River, 8th.

MISCELLANEOUS PHENOMENA.

FOREST AND PRAIRIE FIRES.

Charleston, South Carolina: extensive and destructive forest fires were burning on the 1st between this city and Sumter, along the line of the Central Railroad of South Carolina. At Monck's Corner, thirty-one miles from Charleston, many plantation buildings are reported to have been destroyed. At Stony Landing one hundred cords of wood and other property were destroyed.

Forest and prairie fires were also reported from the following places:

Wilmington, North Carolina: forest fires, 2d, 3d.
 Alva, Florida: forest fires, 27th.
 Fort Sill, Indian Territory: prairie fires, 14th, 18th.
 Fort Reno, Indian Territory: prairie fires, 17th.
 San Antonio, Texas: prairie fires, 21st.

METEORS.

Fall River, Massachusetts: on the 9th, at different times be-

tween 8 p. m. and midnight, numerous meteors were observed starting from near the zenith and passing westward, several of them were followed by bright trains, and a few exploded with a loud report.

At 9 p. m. of the 11th, Geo. W. Smith, master of the schooner "S. B. Vrooman," from Port of Spain, Trinidad, for Mobile, Alabama, in N. 13° 25', W. 65° 55', observed a large meteor passing from south to north, emitting a brilliant light for thirty seconds, and then exploding with a report that jarred the schooner.

Nashua, Hillsborough county, New Hampshire: at 6.09 p. m. of the 14th a meteor, having an apparent diameter of six inches, and followed by a train of red light, was seen to start from near the zenith and pass toward the northeastern horizon.

Grampian Hills, Clearfield county, Pennsylvania: on the 21st, at 7.30 p. m., a large meteor was seen in the western sky 45° above the horizon, and moving toward the south; it resembled a ball of fire, having an apparent diameter of six inches, and followed by a trail of light. The meteor disappeared when at an elevation of about 25°.

Meteors were also observed on the following dates:

California.—Keeler, 19th.
Connecticut.—Bethel, 28th.
Florida.—Archer, 18th; Alva, 19th, 27th.
Illinois.—Geneseo, 6th; Charleston, 19th.
Iowa.—Monticello, 22d.
Kansas.—Salina, 4th, 5th, 7th, 9th.
Louisiana.—Grand Coteau, 12th, 13th, 22d.
Maryland.—Woodstock, 2d, 3d, 11th, 16th, 19th, 21st.
Nebraska.—Valentine, 10th.
Ohio.—Wauseon, 19th, 25th, 29th; Jacksonborough, 21st.
South Carolina.—Spartanburg, 24th, 25th.
Virginia.—Variety Mills, 3d.

MIGRATION OF BIRDS.

Geese flying southward.—Augusta, Georgia, 2d; Chattanooga, Tennessee, 2d; Ninnescab, Kansas, 5th; Brownville, Nebraska, 25th, 28th, 29th; De Soto, Nebraska, 22d; Tatoosh Island, Washington Territory, 9th, 14th, 30th; Albany, Oregon, 8th, 9th, 11th, 30th; East Portland, Oregon, 20th, 22d.

Geese flying northward.—Fort Madison, Iowa, 20th; De Soto, Nebraska, 10th.

POLAR BANDS.

Polar bands were reported from the following stations:

Colorado.—Montrose, 12th.
Connecticut.—Bethel and North Colebrook, 4th.
Florida.—Archer, 3d, 25th, 27th, 28th, 29th.
Illinois.—Riley, 11th.
Kansas.—Ninnescab, 6th, 20th, 29th; Salina, 13th, 29th.
Maine.—Gardiner, 4th, 23d.
Ohio.—Napoleon, 7th, 9th, 10th, 11th, 15th, 22d, 25th, 27th, 28th; Wauseon, 10th, 15th, 20th, 25th.
Tennessee.—Chattanooga, 7th; Nashville, 8th.
Texas.—Abilene, 10th.
Virginia.—Wytheville, 9th, 14th, 19th; Dale Enterprise, 19th.
Wisconsin.—Prairie du Chien, 2d, 3d; Milwaukee, 8th.

SUN SPOTS.

Mr. H. Govey, of North Lewisburg, Champaign county, Ohio, reports having observed sun spots on the following dates: 11th, 16th, 18th, 20th, 27th, 29th.

WATER-SPOUTS.

Capt. L. Dexter, commanding the s. s. "City of Para," reports having observed several water-spouts, between 7 a. m. and 12 noon of the 2d, in N. 37° 38', W. 73° 40' (at noon).

The following is from the "New York Herald" of December 18, 1886:

NEW ORLEANS, December 17.—The British ship "Struan," from Rio Janeiro, reports having encountered, just south of the Mississippi, an enormous collection of water-spouts. The sky was cloudy and the air thick, but the fog suddenly cleared away and showed that the vessel was surrounded by an in-